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AUTHOR Wright, Emmett L.; Nassar, Ita
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ABSTRACT

A significant problem for many schools in the United States is the shortage of qualified mathematics and science teachers entering the profession; this, in turn, is having an adverse effect on the quality of education. The purpose of this study was to survey the 320 mathematics and science education graduates (40% responded) from Kansas State University (KSU), from the years 1975-1988, in order to determine the factors that may have contributed to their leaving or never entering the teaching profession. In addition, the survey provided information for the College of Education at KSU to consider in its efforts to improve the teacher education program. Included is an introduction, methodology, conclusion, recommendations to KSU, and recommendations for further studies. (The document includes 16 tables and 15 references.) (KR)

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An Assessment of Factors Related to the Attrition and Retention of Science and Mathematics Teachers in Kansas

Emmett L. Wright
Kansas State University
College of Education
Manhattan, KS 66506

Ita Nassar
Kansas State University
Division of Biology
Manhattan, KS 66506

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Introduction

A significant problem for many schools in the United States is the shortage of qualified mathematics and science teachers entering the profession, which in turn is having an adverse effect on the quality of education.

A contributing factor to the shortage is a high drop out rate from the teaching profession. There are diverse reasons given for drop out, among which are low salary and dissatisfaction with the profession. This may be due to the lack of public and administrative support. Another reason may be due to inadequate preparation for teaching at the university level.

The specific factors contributing to the science and mathematics teacher shortage need to be determined if progress is to be made in the recruitment and retention of science and mathematics teachers for secondary schools.

Statement of the Problem

There is a shortage of qualified mathematics and science teachers entering secondary education and a high drop out rate of the same teachers from the profession. The purpose of this study was to survey the mathematics and science education graduates from Kansas State University, during the years 1975 through 1988, in order to determine the factors that may have contributed to leaving or never entering the teaching profession. In addition, the survey provided information for the College of Education at Kansas State University to consider in its efforts to improve the teacher education program.

Significance of the Study

This study provided important information to educators involved with the preparation and retention of mathematics and science teachers in secondary education. It is hoped that results of this study will help administrators and educators determine the factors contributing to teacher shortage and drop out from the profession. In addition, information was gathered on the teacher education program in the College of Education at Kansas State University in order to help in its evaluation and possible improvement.

Delimitations of the Study

This study was confined to one sample of science and mathematics education graduates that graduated from Kansas State University during the years 1975 through 1988.

Limitations of the Study

Some bias in the results may have been introduced due to those that did not respond to the questionnaire. In addition, the professional experiences and careers of teachers in this sample may not be representative of the situation at the national level.

Status of the Force

Various studies early in the 1980's indicate a significant shortage of science and mathematics teachers in the United States. To recruit and retain qualified mathematics and science teachers is a serious problem for many school districts (Olstad and Beal, 1984; Guthrie and Zusman, 1982; Howe and Gerlovich, 1981; National Science Foundation, 1980; National Education Association, 1978; Walsh and Walsh, 1980; Walsh, 1980).

It is apparent that few studies, especially in recent years, have dealt with this important issue of shortage of qualified mathematics and science teachers in secondary education. According

to the National Education Association (1978), 22 percent of all secondary mathematics positions across the United States were not filled by certified mathematics teachers or were not filled at all. Graybeal (1984) indicated that the shortage of science and mathematics teachers in the United States exceeds that of other industrialized nations. The NEA (1978) reported that only 41 percent of teachers in science and mathematics who participated in a study in the Boston area planned on staying in the profession. Nationwide more than 17,000 science and mathematics teachers in the United leave secondary schools each year.

According to Dashiell (1983) teachers who leave the profession do so within the first four years of teaching. Furthermore, the drop out from the teaching profession is 40-65 percent. For instance, Walsh (1980) reported that the National Science Teacher Association lost 10 percent of its members in 1980 alone. The National Science Foundation study in the state of Washington by Olstad and Beal (1981) showed that the number of teacher graduates declined by 30 percent in science and 60 percent in mathematics within a five year period. On the other hand, the demand for science and mathematics teachers increased by 35 percent and 76 percent, respectively. Studies in other parts of the country (Howe and Gelovich 1981; Watkins 1981; Guthrie and Zusman 1982) supported these findings.

There are diverse reasons given for the observed shortage of science and mathematics teachers. Industry is drawing qualified mathematics and science teachers away from schools all over the nation (NEA 1981). Teachers may be discouraged from staying in or entering the teaching profession as a result of public criticism of teachers and teacher education. Vance and Schlechty (1982) in a national study concluded that teachers have a relatively low socioeconomic status which might influence their decision to pursue a career in teaching. Science and mathematics graduates tend to prefer higher paying and more respected careers than teaching (Dashiell 1983).

A study of the 1985-86 secondary science/mathematics teaching force revealed a number of factors which appear to be related to teacher retention (Weiss, 1987).

Years of Teaching Experience: the highest attrition rates are among "beginning" teachers and teachers approaching retirement.

Certification/Degree: Science and mathematics teachers with an undergraduate science or mathematics degree and teaching in their certified field were more likely to remain in teaching.

In-Service Education: Teachers active in in-service education activities in their field differentially remained in teaching. Weis cautioned that just because " . . . in-service education is related to teacher retention does not mean that it causes increased retention. An alternative possibility is that those teachers already committed to remaining in the profession are more likely to take advantage of in-service opportunities."

Enjoyment of Teaching: "Science and mathematics teachers who enjoy teaching are more likely to stay in teaching." Eighty percent of the teachers who, in 1985-86, strongly agreed with the statement, "I enjoy teaching science (mathematics)," were still teaching in 1988-89, compared to only 60 percent of the teachers who did not agree.

A more recent follow-up study (Weiss and Boyd, 1990), "revealed that 89 percent of secondary science and mathematics teachers felt that more support from parents would help in teacher retention, and 16 percent of teachers named parental support as the single most important factor in retaining teachers (second only to higher salaries, which was chosen by 52 percent). More than half of the teachers reported that they were dissatisfied with the professional prestige accorded teachers, and 45 percent were dissatisfied with their opportunities for advancement."

When asked why they left the profession, mathematics and science teachers indicated to Weiss and Boyd (1990) the following:

> "Almost 25 percent of the leavers had retired. Eighteen percent mentioned career-related changes, including a promotion to an administrative position, going back to school, or taking a coaching or counseling position, as the main reason they were no longer teaching. Almost as many former teachers (17 percent) said they left the profession for personal reasons, including moving or having a baby, or that they left involuntarily (for reasons such as school closing or layoffs). Only 10 percent of the leavers cited working conditions, such as heavy workload and non-teaching duties, as their primary reason for getting out of the classroom.
>
> Salary was mentioned by 14 percent of the former teachers as their primary reason for leaving the profession. Of those teachers who cited salary as their main reason for leaving teaching, 77 percent were male. Ninety-four percent of the "leavers" said that a 10 percent salary increase would not have made a difference in their decision to leave; and 67 percent said that even a 20 percent raise would not have changed their decision.
>
> However, more than half of current and former teachers named salary as the most important factor in retaining teachers. Working conditions, support from parents, and opportunities for professional development were less frequently mentioned responses."

Methods of Survey Research

Fowler (1980) and Dillman (1978) in discussing survey research methodology pointed out the steps involved in the implementation of a mail survey. These include planning ahead, constructing the questionnaire, pretesting the questionnaire, cover letter, and follow-up mailing. In planning ahead one should consider what data to collect, what population to survey and how to draw the sample, follow-up on nonrespondants, time plan, and cost of the study and what to do with the data.

In constructing a questionnaire it is important to determine the type of information that is needed so as to facilitate the writing of the specific questions. The second major decision is to determine question structure. Four types of structure can be identified: (1) open-ended questions in which respondents create their own answers, (2) close-ended with ordered response choices, (3) close-ended questions with unordered response choices, and (4) partially close-ended questions which, in addition to providing answer choices respondents, have the option of creating their own responses.

Pretesting to identity construction defects is an important part of questionnaire design. Pretesting can be done on colleagues to evaluate the questionnaire in terms of whether it will accomplish the study objectives. Another group for pretesting the questionnaire is selected from the population to be surveyed. This will provide information on what is wrong with the questionnaire and if all questions were clearly understood by the respondents and will be a starting point for revision.

The cover letter to accompany the questionnaire should communicate the problem to the people being interviewed and the need for their help. The individual importance of the respondent to the study's success and confidentiality should also be stressed. It is important also to identify the questionnaire with the name on the mailing list so that follow-up mailing need be sent only to those that do not respond. A pre-addressed, postage-paid return envelope must be included in the mail-out package. Failure to do so may cause an adverse effect on the response rate.

Follow-up on nonrespondants can increase the response rate. Time and cost should be considered in planning follow-up mailings. Usually a post card follow-up is sent to all nonrespondents reminding them of the first mailing and emphasizing that if the study is to be successful it is important that their answers also be included in the results.

Methodology

A problem of major concern in secondary schools of Kansas is the shortage and low retention rate of mathematics and science teachers. Based on the key concepts and concerns that were raised in the literature with regard to this problem, a questionnaire was formulated for mathematics and science teacher graduates of Kansas State University in each of three groups: 1. currently teaching (CT) 2. have previously taught (PT) and 3. have never taught (NT). These questionnaires were constructed to gather information related to demographic characteristics of participants, academic preparation, professional satisfaction and concerns so as to determine the factors that may have bearing on shortage and low retention.

The questionnaires were first reviewed by a panel of university experts and revised. The revised questionnaires were sent to all Manhattan (Kansas) Junior and Senior High School science and mathematics teachers as a pilot study. Based on their response the questions that were misinterpreted were reformulated.

As a third step in the preparation of the questionnaires, they were reviewed by six science and mathematics faculty (panel of experts) of the College of Education, Curriculum and Instruction, Kansas State University. Based on their review and specific comments the questionnaires were revised for a last time.

The completed questionnaires were mailed to the 320 College of Education science and mathematics graduates from the years 1975 through 1988. The list of names and addresses was obtained from the alumni office at Kansas State University. A follow-up card was mailed two weeks after the first mailing, to all those who did not respond.

Out of 320 mailings, a total of 128 were returned, which is a 40% response rate. 0f the 128 respondents 10 responded after the second mailing (3.1%). Among the respondents, there were 75 that are currently teaching (CT), 35 that previously taught (PT) and 18 that have never taught (NT).

The analysis included frequency and percent distributions for most of the variables by the three groups (CT, PT, NT). Contingency chi-square analyses were performed, where appropriate, to determine if differences existed among the three groups with regard to certain variables or questions.

In addition to the statistical analysis, questions dealing with opinions and comments were summarized in the text and in Appendix A.

Contingency chi-square analyses revealed that there were significant differences at the .05 level among the three groups (CT, PT and NT) only with regard to age (table 2), number of years taught (table 11), and years in present position (table 11). Only the chi-square values

for those analyses that showed significance are presented (tables 2 and 11). Results in table 2 show that 30.6% of CT, 0% of PT, and 50% of NT were age 20-25. As expected, the PT group was older than the CT or NT group. Those that never taught were the youngest among the three groups. Table (11) indicates that 64% of CT and 85.7% of PT have taught from one to five years. Twenty four percent of CT and 14.3% of PT taught from 6 to 10 years. Twelve percent of CT and 0% of PT taught between 11 and 14 years. Eighty percent of CT and 54.2% of PT had between one and five years in their present position. On the other hand, 20% of CT and 45.7% of PT had between 6 to 10 years in present position.

Results in Table 1 show that of those currently teaching (CT), 22.6% graduated between 1974 and 1978, 16% between 1979 and 1983, and 61.3% between 1984 and 1988. For those that previously taught (PT), the figures were 48.6%, 40%, and 11.4%, respectively. Among the respondents that never taught (NT), four did not respond to this question. 0f those that responded, 7.1% graduated between 1974 and 1978, 7.1% between 1979 and 1983, and 85.7% between 1984 and 1988. Thus, it is seen that the majority of CT and NT are recent graduates (within the last 5 years). As expected, the majority of those that previously taught graduated more than 10 years ago.

Table 2 shows that 72% of CT, 77.2% of PT, and 72% of NT are married. Also, 61.7% of CT, 54.3% of PT, and 44.4%. of NT are males. It appears that the proportion of males is highest among those currently teaching and lowest among those that never taught. In accord with the time of graduation, the age distribution indicates younger age groups for CT and NT than for PT.

Table 1. Distribution by year graduated for those that are currently teaching (CT), have previously taught (PT), and never taught (NT). P = percent, F = frequency.

Year graduated	CT		PT		NT	
	P	F	P	F	P	F
74-78	22.6	17	48.6	17	7.1	1
79-83	16.0	12	40.0	14	7.1	1
84-88	61.3	46	11.4	4	85.7	12
Total		75		35		14

Table 2. Age distribution, gender and marital status for the currently teaching (CT), previously taught (PT), and never taught (NT) groups. F = frequency.

Age group	CT		PT		NT	
	P	F	P	F	P	F
20-25	30.6	23	0.0	0	50.0	9
26-30	29.3	22	28.6	10	11.0	2
31-35	28.0	21	48.6	17	22.2	4
36-40	8.0	6	14.3	5	11.0	2
41+	4.0	3	8.6	3	5.6	1
Total		75		35		18
Married	72.0	53	77.2	27	72.0	13
Male	61.7	42	54.3	19	44.4	8

Contingency chi-square for age by group = 21.75 with 8 degrees of freedom. This is significant at the .05 level.

Table 3 presents the areas of certification for each of CT, PT, and NT. A contingency chi-square analysis showed no significant differences among the three groups with regard tocertification. Hence, considering all three groups, it is seen that 59% were certified in biology, 66% in chemistry, 48.6% in general science, 17. I% in physical science, 62% in mathematics, 37.1% in physics, 10.5% in computer science, and 3.8% in language. People were certified in more than one field as evident by the fact that the sum of all percentages exceeds 100%. Bachelors of science degrees in teaching fields were mostly in biology and mathematics (College of Arts and Science). Of those currently teaching, 6.7% have a B.S. degree in mathematics (College of Arts and Science). On the other hand, 20% of PT and 0.0% of NT have a degree in mathematics (Table 4). Of the 128 respondents, a total fo 39 (30.5% have a masters degree and 9 (6.3%) have a Ph.D. or Ed.D. degree.

On a yes-or-no answer to the question of whether the teacher education program at Kansas State University prepared them well enough for student teaching, 61% of those that never taught thought that Kansas State University prepared them well for teaching. However, the 39% (7 out of 18) did not think they were well prepared to teach, gave reasons including: (1) lack of practical experience such as how to deal with students emotional problems and discipline in the classroom, (2) not enough hands-on experience with teaching, and (3) not enough illustrations of good secondary school teaching.

On a scale from 1 (poor) to 4 (excellent) about 70% of all respondents gave a rating of 3 or 4 to their student teaching experience. Also, between 78 and 80% gave a rating of 3 or 4 to their supervising high school teacher (Table 5). Reasons given for negative experiences in student teaching were the lack of preparation for classroom management, lack of practical experience, and excessive commuting time. Those that considered their student teaching a positive experience had good guidance and supervision from excellent cooperating teachers. Positive comments about the supervising secondary teachers were good communication, guidance, leadership, and good classroom management. Negative comments were indifference, poor cooperation, and lack of guidance. The majority of respondents felt the need for more cooperation on the part of the secondary teacher and for better communication and guidance. For example, the student teacher needs to spend time with the cooperating teacher to coordinate and obtain information as to the level and type of courses taught before the start of student teaching. It was suggested that secondary teaching experience should start early in college before the senior year so as to gain more exposure to teaching and to be able to make a career change in case teaching is found to be unappealing. Also, a better preparation at the university level through taking more courses in science and mathematics content and more experiences in how to teach were deemed essential by the respondents.

Table 6 indicated that 44% of current teachers, 43% of those that previously taught and 29% of those that never taught first decided on a teaching career in high school. On the other hand, 48% of CT, 57.1% of PT, and 65% of NT first decided to become teachers at the university level. This indicates that the majority of those going into teaching tend to make their decision at the university level.

On the question of higher salaries for science and mathematics teachers, 72% of CT and 60% of PT were concerned that a higher salary might create hostility and discontent among other teachers. A suggested alternative was that science teachers should have more preparation time since science is the most difficult subject to teach. Justifications given for a higher salary were the time involvement with laboratory preparation and the more difficult courses that mathematics and science teachers have to teach. In addition, higher salary was cited as the only way to keep the best teachers in the profession. Mathematics and science teachers are in a highly competitive field and should be justly compensated. Also, a higher salary is particularly justifiable if the teacher has a degree (other than in the college of education) in teaching field.

Table 3. Areas of certification distribution for the currently teaching (CT), previously taught (PT), and never taught (NT) groups. P = percent, F = frequency.

Area of Certification	CT		PT		NT		Total for CT, PT, NT
	P	F	P	F	P	F	P
Biology	41.3	31	54.3	19	66.7	12	59.0
Chemistry	50.6	38	57.1	20	61.0	11	66.0
General Science	38.6	29	42.8	15	38.9	7	48.6
Physical Science	13.3	10	8.6	3	27.7	5	17.1
Mathematics	58.6	44	45.7	16	27.7	5	62.0
Language	2.6	2	2.8	1	5.5	1	3.8
Physics	36.0	27	20.0	7	27.7	5	37.1
Computer	13.3	10	2.8	1	0.0	0	10.5
Others	8.0	6	2.8	1	0.0	0	6.6
Total Respondents		75		18		12	105
No Response		0		17		6	

Table 4. Distribution of degrees earned in academic field (in the College of Arts and Science) for those currently teaching (CT), previously taught (PT), and never taught (NT). P = percent, F = frequency.

Bachelors	CT		PT		NT	
	P	F	P	F	P	F
Biology	16.0	12	11.4	4	33.3	6
Chemistry	4.0	3	2.9	1	0.0	0
Mathematics	6.7	5	20.0	7	0.0	0
Physics	1.3	1	5.7	2	0.0	0
Others	2.6	2	5.7	2	0.0	0
No degree in Arts and Science	69.3	52	54.3	19	66.6	12
Number Responded		75		35		18

Table 5. Rating of student teaching experience and supervising secondary teacher by those that are currently teaching (CT), previously taught (PT), or never taught (NT). P = percent, F = frequency.

Teaching experience rating	CT		PT		NT	
	P	F	P	F	P	F
1 (poor)	9.3	7	14.3	5	11.1	2
2	12.0	9	14.3	5	11.1	2
3	44.0	33	20.0	7	38.9	7
4 (excellent)	34.0	26	51.4	18	38.9	7
Secondary supervisor rating						
1 (poor)	10.0	8	11.4	4	5.6	1
2	9.0	7	5.7	2	16.7	3
3	29.0	22	25.7	9	16.7	3
4 (excellent)	49.0	37	57.1	20	61.0	11
Total Respondents		75		35		18

Table 6. Frequency table of time decision first made to become a teacher for those that are currently teaching (CT), have previously taught (PT), or never taught (NT). P = percent, F = Frequency.

Time decision made	CT		PT		NT	
	P	F	P	F	P	F
High school	44.0	33	42.9	15	29.4	5
University	48.0	36	57.1	20	64.7	11
Post university	8.0	6	0.0	0	5.9	1
Total respondents		75		35		17

The most helpful education courses cited by the respondents were methods, laboratory techniques, and microteaching. The least helpful course cited was educational psychology (Table 7). As to which courses should be emphasized in the curriculum, respondents cited methods, video lessons of master teachers, microteaching, and a course on how schools are administered, laboratory techniques, and adolescent psychology (Table 8). In addition, it was suggested that courses should emphasize classroom management, discipline, and motivating students; lesson preparation skills, and self evaluating skills. Also, courses that bring in practicing teachers should be offered.

Among those that previously taught or never taught, 28.6% and 55.6% respectively indicated that their future plans include teaching. Sixty percent of those that previously taught were employed as mathematics teachers before leaving the profession. The majority of the PT respondents were employed in white collar jobs or as professionals (lawyer, dentist, M.D., D. V. M., and farmer). Of the never taught respondents the majority were also employed in white collar jobs or as professionals (Table 9).

Table 10 shows that all the CT respondents were involved in non-teaching school related duties. Forty-four percent were involved in coaching, 26.3% in club counseling, and 11.8% in cheerleading. On the yes and no answer to the question of whether one is required to teach courses in subjects other than those for which one is certified, 13.2% of those currently teaching teach courses in which they are not certified. The same was true among 37.1% of those that previously taught.

As is shown in Table 11, the majority (64%) of those that are currently teaching are in the first 5 years of their teaching career. The majority (80%) have been also in their present position from 1 to 5 years. For the PT respondents, 85.7% were in their teaching profession between 1 and 5 years and 54.5% have been in their present non-teaching position from 1 to 5 years.

It is interesting to note (Table 12) that 20% of CT and 48.6% of PT respondents indicated a teacher shortage in mathematics. Twenty-four percent of CT and 42.9% of PT indicated a teacher shortage in science in their schools.

Among the various fields of science the shortage (as perceived by CT) ranged from 1.3% in computer science to 9.3% in physics. On the other hand, the range (as perceived by PT) was from 2.8% in computer science and physical science to 25.7% in physics.

Regarding the question of satisfaction with their present position, 80% were satisfied. Those not satisfied (20%) complained about the low intellectual level of students, little support with discipline problems, too little autonomy, lack of incentives to stay in teaching, and poor administration. In addition, they felt taken advantage of with the excessive workload. As far as respect is concerned, 70.6% indicated that teachers are respected in their communities. Those that do not think teachers are respected feel that, in general, the knowledge of a teacher is respected, but not the occupation as such. Teachers are often respected for their coaching rather than their teaching. Teachers are, perhaps, better respected in lower socio-economic areas where parents often want their children to be better educated than they are.

Results in Table 13 show that among those currently teaching 21.3% wish to retire from teaching within the next 5 years, 9.3% within the next 10 to 20 years, 5.3% within the next 25 to 32 years, 38% at age 65, and 24% are undecided. This indicates that more than 20% will leave the teaching profession within 5 years. This is a minimum estimate since there is a possibility that some of the 24% undecided will also leave.

Table 7. Education courses that are most or least helpful (MH, LH) as judged by the three groups, currently teaching (CT), previously taught (PT), and never taught (NT).

Courses	CT		PT		NT	
	MH	LH	MH	LH	MH	LH
	Percent		Percent		Percent	
Science/Math Curriculum	4.0	1.3	11.4	1.3	22.2	0.0
Educational Psychology	17.3	22.6	25.7	20.0	16.6	33.3
Instructional Media	4.0	9.3	8.6	11.4	11.1	0.0
Psychology of the Exceptional Child	4.0	5.3	8.6	17.1	16.6	5.5
Methods	30.6	10.6	8.6	2.9	55.5	0.0
Laboratory Techniques	29.3	2.6	11.4	2.8	22.2	5.5
Principles of Education	2.6	9.3	0.0	2.8	0.0	27.7
Micro Teaching	17.3	2.6	17.1	0.0	22.2	0.0
Teaching Block	10.6	2.6	8.6	5.7	0.0	0.0
All of them	1.3	2.6	0.0	5.7	0.0	0.0
None	4.0	6.6	20.0	0.0	0.0	0.0
Total respondents	75		35		18	

Table 8. Courses which should be emphasized as indicated by each of the three groups, currently teaching (CT), previously taught (PT), and never taught (NT). P = percent, F = frequency.

Course	CT		PT		NT	
	P	F	P	F	P	F
Science/Math Curriculum	2.6	2	2.8	1	0.0	0
Edcational Psychology	4.0	3	0.0	0	0.0	0
Computers	5.3	4	2.8	1	5.5	1
Methods	21.3	16	8.6	3	5.5	1
Laboratory Techniques	10.6	8	2.8	1	5.5	1
Adolescent Psychology	10.6	8	0.0	0	27.7	5
A course on how Schools are Administered	16.0	12	2.8	1	5.5	1
Course that Examines the Characteristics of master teachers	20.0	15	2.8	1	0.0	0
Undecided	9.3	7	77.1	27	44.4	8
Total respondents		75		35		18

Table 9. Employment since graduation for those that previously taught (PT) and those that never taught (NT). Note that the percentages do not sum to 100% since some were employed in more than one area since graduation. P = percent, F = frequency.

Type of Employment since graduation	PT		NT	
	P	F	P	F
Math teacher	60.0	21	0.0	0
White collar	25.7	9	27.7	5
Administration	5.7	2	0.0	0
University	5.3	4	0.0	0
Professionals (lawyer, dentist M.D., D.V.M, farmer)	17.3	17	31.4	11
Others	0.0	0	20.0	7
Total respondents		35		18

Table 10. Non-teaching school related duties for those currently teaching (CT).

Non-teaching Duties	Percent	Frequency
Cheerleading	12.0	9
Club, Counseling	26.6	20
Professional development	6.7	5
Faculty senate	1.3	1
Hospitality committee	9.3	7
Coaching	44.0	33
Total respondents		75

Table 11. Number of years taught and years in present position for those currently teaching (CI) and those that previously taught (PT). P = percent, F = frequency.

Number of years taught	CT		PT	
	P	F	P	F
1-5	64.0	48	85.7	30
6-10	24.0	18	14.3	5
11-14	12.0	9	0.0	0
Total respondents		75		18
	Years in Present Position			
1-5	80.0	60	54.2	19
6-10	20.0	15	45.7	16
Total respondents		75		35

The contingency chi-square for number of years taught by group = 7.42 with 2 degrees of freedom. This value is significant at the 5% level.

The chi-square for years in present position by group = 7.74 with 1 degree of freedom. This chi-square value is significant at the .05 level.

Table 12. Teacher shortage as perceived by those currently teaching (CT) and those that have previously taught (PT). P = percent, F = frequency.

Field	CT		PT	
	P	F	P	F
Mathematics	20.0	15	48.6	17
Science	24.0	18	42.8	15
Do not know	56.0	42	8.6	3
Total respondents		75		35
Breakdown of science teacher shortage				
1. Biology	4.0	3	11.4	4
2. Chemistry	5.3	4	14.2	5
3. General Sci.	2.6	2	8.6	3
4. Physical Sci.	6.6	5	2.8	1
5. Physics	9.3	7	25.7	9
6. Computer	1.3	1	2.8	1
7. All Sciences	5.3	4	5.7	2

Results in the following three paragraphs are not tabulated since they were drawn from open-ended questions. Of those currently teaching 89.3% are employed in their major teaching field and 58.6% did not find lesson preparation time alloted by their schools to be sufficient. Also, 69.3% indicated that additional mathematics and science courses would be valuable. Of the CT respondents 36.3% believe that additional mathematics and science courses should be taken during the college years, while 63.7% prefer more science and mathematics courses after graduation or after having been in the profession for a time.

Thirty percent of the teachers (CT) surveyed feel isolated in their profession. The reasons given were that teachers had very little contact with other teachers in the field, either because they had no time to communicate with peers, or they were the only teachers in their field in their school. Also, they had no contact with the real science world and felt out of touch with the rest of the adult working population. Regarding the question of opportunities to keep up in their profession, 69.3% felt that they are given such opportunities by their schools. The incentives given by different schools included meetings teachers can attend, pay for all workshops, time out to attend classes, partial pay for education, free education for advanced degrees, and pay for one year off to pursue education in return for two years of teaching at the same school.

Results in Table 14 indicate that 39.7% of teachers (CT) attended 1 to 3 workshops during the last year and 4.4% attended 4 to 7 workshops. During two years prior to last year, 35.3% of teachers (CT) attended 1 to 3 workshops and 14.7% attended between 4 and 18 workshops.

Prior to the last three years, 19% of teachers (CT) attended 1 to 3 workshops and 10.2% attended 4 to 18 workshops. Sixty-one point 7 percent of these workshops were school sponsored.

From Table 15 it is seen that 20% of the teachers (CT) are members of the professional society NCTM, 20% of KATM and KATS, 16% of NSTA, 14.6% of NEA and KNEA. The percentage of members actively involved in their professional organizations is less than 7%. Results in Table 16 show that 41.2% of teachers subscribe to The Mathematics Teacher, The Science Teacher, and NEA and KNEA professional journals. These same journals are also read by 34.6% of the teachers.

What follows is a summary of the consensus of the different answers given to the open-ended questions which was not feasible to present in tabular form. According to the respondents, the teacher education program at Kansas State University can be improved by placing undergraduates into the secondary classroom as early as the freshman year. This would give the students actual teaching experience in all grade levels and in all science and mathematics subjects. As such, the education classes at the University would be more meaningful. There is also a need for more hands-on experience outside the classroom as, for example, through Big Brothers and Big Sisters, teacher aiding, or coaching. At the university level there is a need for more courses in subject matter content.

Teachers should major in their chosen field (other than education) so that they will be prepared to teach higher level courses such as anatomy, physiology, and cell biology. Besides, there is a need for more science and mathematics at the university level. More courses should be given at the level pertaining to the masters program in education. The overlap in information and projects in education classes should be eliminated.
There should also be an ample opportunity to observe the teaching of actual master teachers, perhaps through video.

Table 13. Number of years (starting December 1988) till retirement from teaching.

Years	Percent	Frequency
1-5	21.3	16
10-20	9.3	7
25-32	4.0	3
at age 65	38.6	29
Undecided	24.0	18
No response	2.7	2
Total respondents		73

Table 14. Science related workshops attended by those currently teaching.

Number of workshops Last year	Percent	Frequency
1 - 3	39.7	27
4 - 7	4.4	3
Two years prior to last year		
1 - 3	35.3	24
4 - 7	10.3	7
0 - 18	4.4	3
Prior to last 3 years		
1 - 3	19.1	13
4 - 7	5.8	4
10 - 18	4.4	3
No response		7
Total respondents		68

Table 15. Membership and involvement in Professional organizations for those currently teaching. P = percent, F = frequency.

Teacher:	Member				Actively involved			
	Math		Science		Math		Science	
Organization	P	F	P	F	P	F	P	F
NCTM	33.3	11	9.5	4	0.0	0	4.7	2
KATM, KATS	24.2	8	16.7	7	9.1	3	2.4	1
NSTA	9.1	3	21.4	9	3.0	1	9.5	4
NEA, KNEA	33.3	11	0.0	0	3.0	1	4.7	2
Phi Delta Kappa	3.0	1	7.1	3	3.0	1	4.7	2
NABT	0.0	0	9.5	4	0.0	0	0.0	0
Coach	3.0	1	7.1	3	0.0	0	2.4	1
NATM, KAMLE	6.1	2	0.0	0	0.0	0	9.5	4

Others
1. WFT, AFT
2. PEA
3. KCA
4. NCA
5. AAPT
6. NSAA
7. KAECT
8. ASCD
9. Chem teachers
10. Voc. Agr.
11. LEA
12. Honors

Total respondents Math: 33 Science: 42

Table 16. Membership in professional Journals for those currently teaching. P = percent, F = frequency.

Teacher: Journal	Received Math P	Received Math F	Received Science P	Received Science F	Read on Regular Basis Math P	Read on Regular Basis Math F	Read on Regular Basis Science P	Read on Regular Basis Science F
Math. Teacher	33.3	11	7.1	3	33.3	11	2.4	1
Science Teacher	9.I	3	14.3	6	9.1	3	14.2	6
Phi Delta Kappa	3.0	1	7.1	3	3.0	1	4.8	2
Computer	3.0	1	4.8	2	3.0	1	0.0	0
American Biology Teacher	3.0	1	4.8	2	3.O	1	4.8	2
Coaching	6.1	2	2.4	1	3.0	1	0.0	0
Chem Teacher	3.0	1	2.4	1	3.0	1	0.0	0
The Physics Teacher	3.0	1	2.4	1	3.0	1	0.0	0
Scientific American	0.0	0	2.4	1	0.0	0	2.4	1
Discover	0.0	0	2.4	1	0.0	0	2.4	1
Science digest	0.0	0	2.4	1	0.0	0	2.4	1
Total respondents	Math: 33		Science: 4					

Instruction in the College of Education, according to some, is too idealistic. What is needed is practical, realistic, situational teaching and teaching techniques with methods to motivate and discipline. Students should be made more aware of outside resources that will bring variety to their classes. More information should be given on the general operation of schools with programs specific to rural, suburban, and inner city schools.

Regarding the length of time that would be preferred as a student teacher, 64% of the respondents (CT and PT) expressed the need for a whole semester of student teaching with more than one cooperating teacher and in more than one school at different grade levels. Several respondents thought that one year would be better, or perhaps even two years with the second year spent as a substitute teacher.

To the question why they left teaching, 46% gave financial reason for leaving the teaching profession. The second reason was too many extra-curricular activities which left little time to prepare for classes or to spend with their families. They were tired of discipline problems and student apathy and of not receiving any appreciation or support from the administration. They were also discouraged with the poor quality of teachers in the system. Too many it was simply too much stress, pressure, and responsibility for too small a compensation, financial as well as well as emotional.

Of the NT group 27.7% never went into teaching because, so far, they were unable to find a job. Thirty-three point three percent found higher paying jobs with no take home work and no extracurricular activities. Eleven percent wanted to raise a family. The rest (28%) had changed their mind about teaching during their time as student teachers. They decided not to battle student disrespect, low standards, lack of support, and long hours for little pay.

On the question of why did you want to become a teacher, 11% said that teaching is a family tradition, their fathers and/or mothers are in the profession, and it was not a hard choice to make. Wanting to combine their interest in people with their interest in science and/or mathematics lead others to become teachers. In addition, others went into teaching because they looked up to and respected their high school teachers, while others thought they could do a better job than their high school teachers explaining mathematics and science. Many went into teaching because they like to coach. Summers off are attractive to some of the teachers, especially mothers with children.

The best thing about teaching is, for many, the interpersonal communication with students. The humor of and the positive feedback from students, and seeing them excited about subject matter makes teaching a never-boring challenge. "The freedom to direct one's own class, especially in upper level subjects with upper level students, that's what teaching is all about." For some, the best thing about teaching is coaching and summers off. The least thing liked about teaching is dealing with discipline problems and unmotivated, apathetic, and failing students. Besides, there is too much time spent in school on extracurricular activities and all those other little duties and responsibilities. Then there are the constant daily schedule interruptions, the stress caused by lack of real input by teachers into decision-making, and the poor attitude of students, parents and some teachers with little administrative support. All these factors make it seem that learning is one of the least important goals of public schools.

When asked about the incentive needed to attract new teachers to the profession, 66% of CT and 65.7% of PT said that a higher salary with benefits comparable to industry will attract the best teachers to the profession. Next to salary there must be a supportive administration that lets teachers teach and hires para-professional help for the paper work and other non-teaching duties. Teachers should not be burdened with anything other than teaching duties unless justly compensated. Also, the teacher must be given more freedom on how to run his/her

own classroom and be released from the discipline cat-and-mouse game. There must be smaller and fewer classes taught per day to give teachers more time for in-school lesson preparation and less take-home work. There is a need for well-controlled schools as well as students and desirable classroom situations, because prospective teachers need a positive experience in high school. Furthermore, there should be better recruitment by colleges, better preparation, and higher standards in the university and also placement of teachers by the university. New teachers should have a mentor or partner teacher and continued guidance from the university for at least one year.

To keep teachers in the profession, 56% of CT and 51.4% of PT think that more money will keep most teachers teaching. Also, administrators are very important in keeping teachers in the profession. Extracurricular duties should be eliminated or greatly reduced because preparing for lectures, labs, exams, and grading papers for 100 to 125 students makes a 12 to 15 hour day. Teachers should be treated as professionals. They should be given the opportunity to have input in school board decisions regarding the schedule and curriculum. Furthermore, teachers should have more control in discipline situations. There must be a better cooperation and communication between school board, administration, and fellow teachers. For the purpose of recertification, teachers should have time off, perhaps in the form of a sabbatical, especially for teachers in rural areas, and free tuition for continuing education. Last, but not least, tenure should be eliminated to encourage professionalism.

In summary, the major reason given for leaving the profession are low salaries, discipline problems, excessive extracurricular activities, and lack of administrative support. Factors that could convince teachers to stay in the profession are higher salaries, significant reduction in extracurricular activities, more teacher input in school board decisions regarding schedule and curriculum and more teacher control in discipline situation.

Conclusion

Many United States school districts are faced with shortages of qualified mathematics and science teachers which is having an adverse effect on the quality of education. Data are needed to identify the major factors responsible for teacher shortage which would help in finding a solution to the problem.

This study reports on a follow-up survey of mathematics and science students that graduated from Kansas State University, in the years 1975 through 1988, to determine the factors that may contribute to students remaining, leaving, or never entering the teaching profession and to provide information that may help in the re-evaluation of the Kansas State University teacher education program.

Results from this study indicate that inadequate salary is a major factor causing mathematics and science teachers to leave or never enter the teaching profession.

Another major factor in this regard is the current structure of the school system in secondary education. Problems of importance in the schools are discipline in the classroom, administrative support for the teacher and a heavy load of extracurricular activities, leaving little time for adequate preparation for teaching.

A third factor is the poor "quality" of many teachers in the system and a negative student teaching experience. This seems to adversely affect collegial cooperation and the positive attitude towards students.

A fourth factor is the extent and type of preparation at the university. In addition to improving teacher salaries and restructuring the curriculum system to provide for adequate classroom preparation and better teaching and discipline in the classroom, education curricula can be improved in course offering and in student teaching experiences to help students be better prepared for a teaching career.

Negative experiences in student teaching are due to lack of preparation for classroom management, lack of practical experience in teaching, too much commuting time, and above all, lack of guidance and supervision by the supervising secondary teacher. As a result, it was suggested that students need to spend more time with the supervising secondary teacher coordinating classroom teaching. Also, secondary teachers should be carefully selected for supervision of student teachers.

Student teaching experiences should start early in university preparation, before the senior year, to gain more exposure to teaching and to be able to make a career change in case teaching does not appeal to a student. This could be then a selection process that may reduce the rate of drop out at a later stage from the teaching profession. It was also considered necessary that more time, like a whole semester, is needed for student teaching with more than one supervising secondary teacher, at different grade levels and perhaps different schools (rural, suburban, and inner city).

A better preparation at the university level was deemed essential by the respondents. This could be accomplished by taking additional courses in subject matter and by conducting teaching labs in order to provide students with more teaching experience. In terms of education courses, the most helpful (as cited by the respondents) were methods, laboratory techniques, and microteaching.

In addition, it was suggested that courses should be emphasized that deal with classroom management, discipline, and motivation of students; courses in adolescent psychology and the general operation of schools. Also, courses that bring in practicing teachers or master teachers through video presentations should be offered.

Recommendations to Kansas State University

Based on my personal assessment of the results of this study (i.e., responses to questions and additional comments made by the respondents) and on my own extrapolation from these findings, the following recommendations are proposed.

To adequately prepare undergraduate science and mathematics students for a teaching career, the teacher education program at Kansas State University should consider offering a teaching laboratory (a course where students experiment with and gain experience in teaching and classroom management) for the four years of the curriculum. As part of the teaching laboratory, students should visit classes (two to three times per week, an hour each time) at secondary schools as observers and as teacher assistants. This will expose the students from early on to the classroom environment, to the problems encountered in daily teaching, and to classroom management. During the second two years (after knowledge in subject matter has been acquired) students should be involved in preparing lesson plans for every subject they will be certified to teach, according to the latest secondary school texts being offered. Students should teach from these lesson plans on a regular basis to their peers under the supervision of their university professors.

The last semester of their four year study students should be involved in classroom teaching at secondary schools under supervision of a cooperating secondary teacher. As such, the program will be less dependent on finding good supervising secondary teachers willing to take student teachers.

In addition to training students in teaching, the teaching laboratory should offer videos of practicing teachers and master teachers. This would give the students examples of real teaching situations on a wider scale.

In addition to the teaching laboratory students should take more content courses with application to their teaching field. This will make them more knowledgeable and hence more comfortable in teaching any level of subject offered in secondary schools. A course in adolescent psychology is beneficial in understanding students' behavior and ways to cope with it. Also, there is a need to be more involved with professional societies as undergraduates.

Certain strategies to improve teacher quality and retention should be followed. These include: (1) recruitment practices that attract capable prospective mathematics and science teachers to the field of teaching (this has to start with creating a favorable public image of the teaching profession); (2) the selection of cooperating secondary teachers for student teaching should be done with care so that the student teacher will have the necessary guidance and support needed for a positive outlook on teaching; (3) a follow-up and academic support of the beginning teacher for at least one year by the Department of Curriculum and Instruction; and (4) there should be good communication between the schools and the Department of Curriculum and Instruction which is essential for evaluation and improvement of the teacher preparation program.

Recommendations for Further Studies

Further studies of this type could be done first on all institutions in Kansas so as to give a wider data base from which one may improve the teacher education program at Kansas State University and other institutions.

Follow-up surveys on mathematics and science education graduates after their first year of graduation will provide information that would help in a continuous re-evaluation and improvement of the teacher education program at Kansas State University. Such surveys may include indepth interviews with teachers that stay, leave, or never enter the profession to determine what factors influence their decisions. These surveys should also include a rating by administrators of teachers who stay in and who left the profession. One may also correlate academic performance of teachers (such as G.P.A. or other standardized indicators) with whether they remain in or leave teaching.

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